Can Water Replace Solvents for Metal Cleaning?

- **With a combination of the right chemistry, equipment and cleaning process**

For decades, ultrasonic and mechanical cleaning has proven effective and efficient. Understanding and appreciating these cleaning systems is critical when deciding whether to replace chlorinated solvent cleaning. Updated federal EPA regulations and mandates have been major driving forces in the focus to replace cleaning with chlorinated solvents.

1. Ultrasonic Cleaning

Ultrasonic cleaning builds upon the concept of soak cleaning by adding the use of high frequency sound or ultrasonic waves. A combination of chemistry and this form of energy effectively removes a wide variety of soils including, but not limited to:

- oils
- greases
- buffing & polishing compounds
- paraffins & waxes, abrasives
- rouges
- metallic chips
- fragments
- shavings

Ultrasonic cleaning systems are ideal for removing soils mechanically imbedded in recessed areas like lettering, designs and the inner diameters of tubing.

a. How Ultrasonic Cleaning Works

An ultrasonic generator, coupled with a transducer unit, changes the signal to mechanical energy, which in turn produces a favorable cavitation action that scrubs parts clean. Typically, the transducers are 20 kHz; however, for specialized applications, 40-100 kHz can also be used. In the working solution, cavitation intensity increases as the temperature of the cleaning solution increases. This usually holds up to a solution temperature of 160 deg F (71 deg C). Beyond this temperature, cavitation steadily decreases.

b. Racking, Fixturing and Positioning

Key to ultrasonic success is the careful racking or fixturing of parts. This maximizes exposure to desired levels of ultrasonic energy, thereby enhancing the effectiveness of the cleaner chemistry. Design and fixturing of parts promotes good solution drainage, prevents air entrapment, and allows for favorable penetration of ultrasonic energy. Similarly, there is an optimal alignment of transducer to parts, so routine maintenance of the transducer is crucial to performance.

c. Chemistry Makes a Difference

Aluminum, brass, white metal and zinc are metals commonly cleaned ultrasonically. The appropriate cleaner formulation is compatible with the substrate to be cleaned. Ultrasonic cleaning solutions normally provide formulations in the pH range of 8-13. Cleaning non-ferrous or more sensitive metals may also require inhibitors in the cleaner concentrate. Ultrasonic cleaning may be the first step in surface preparation or it may precede a soak cleaner.

d. Drying to Complete the Process

If cleaning the parts is the sole requirement, proper drying is essential. Mechanical dryers such as spin units, hot air knives, or centrifugal types are used most commonly for this purpose.

e. Additional Considerations

Most ultrasonic cleaning formulations impart a protective film over the base metal. A soak cleaner dip is usually sufficient to remove this film, followed by proper drying. In a plating cycle, the soak cleaner may be followed by or substituted with an electrocleaner to remove the inhibitor film, making the parts clean, free-rinsing and ready for surface activation. It is important to use the correct electrocleaner to avoid tarnish, etch or pitting the surface of a non-ferrous metal.

2. Mechanical Cleaning

Mechanical cleaning makes quick work of soil removal. It is an economical yet effective method for bulk-cleaning stamped and mechanically formed parts. It is particularly effective when aligned with paint, powder-coat and phosphate lines.

This type of cleaning combines chemical and mechanical energy. Its comparatively lower temperature requirement - ranging from 120-150 deg F (49-66 deg C) - reduces heating costs as it lowers energy demands. Sprays and other forms of agitation during the cycle provide significant mechanical force, improving the removal of soils overall.

Cleaner blends are low-foaming and blended with powerful solvents (SARA Title III exempt types), dispersants and water conditioners (to prevent the plugging of spray nozzles). The pH of cleaners range from near neutral to 14. Blends are available for all sensitive metals, non-ferrous and ferrous types.

The appropriate mechanical action for the job at hand is critical to cleaning success.

- In spray cleaning, the PSI application is key for part coverage and the optimization of soil displacement.
- In wash machines, agitation trays or baskets of parts are placed in sealed compartments. Up / down, rotational and / or side-to-side action occurs. For optimal performance, racking of parts or placement in bulk tubs must be considered in parts configuration or design.

To extend cleaner-bath service life, simplify waste treatment and realize further cost savings, recirculation tanks can be continually skimmed to remove oily and grease soils.

3. Equipment Considerations

Converting to an aqueous cleaning operation is easier than you might think, considering the design and space allocation.

3 criteria to consider include:

1. Heating: Electric immersion, insulating hot water, steam or gas fired.
2. Dryers: centrifugal or forced air.
3. Washers: Configurations include single-station spray cabinets, multi-station (three- or five-stage) and automated, rotating, sealed washers.

4. Further Process Consideration

Ultrasonic and mechanical cleaning incorporate a cycle comprised of stationary treatment stations, rinses, and drying. Chlorinated solvent cleaning, on the other hand, is much simpler in application. Dry and soiled parts enter the enclosed solvent degreasing unit. Upon completion of the cleaning cycle, the parts exit clean and dry. Compared to chlorinated solvents, it may take up to seven times longer to produce clean, dry parts in the ultrasonic & mechanical cleaning system. (Not to mention the increased use of water and energy source requirements.)

So why switch?

The most significant reason has been the environmental concerns and safety issues that have been identified with chlorinated solvents. Beginning with the ozone depletion discovery detailed in The Montreal Protocol. Further regulations stemming from the EPA and OSHA regarding air, water and soil contamination as well as worker safety considerations. All of which have increased the scrutiny on all solvent cleaning and provided alternatives cleaning chemistries an opportunity to gain more acceptance.

Our people. Your problem solvers.

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